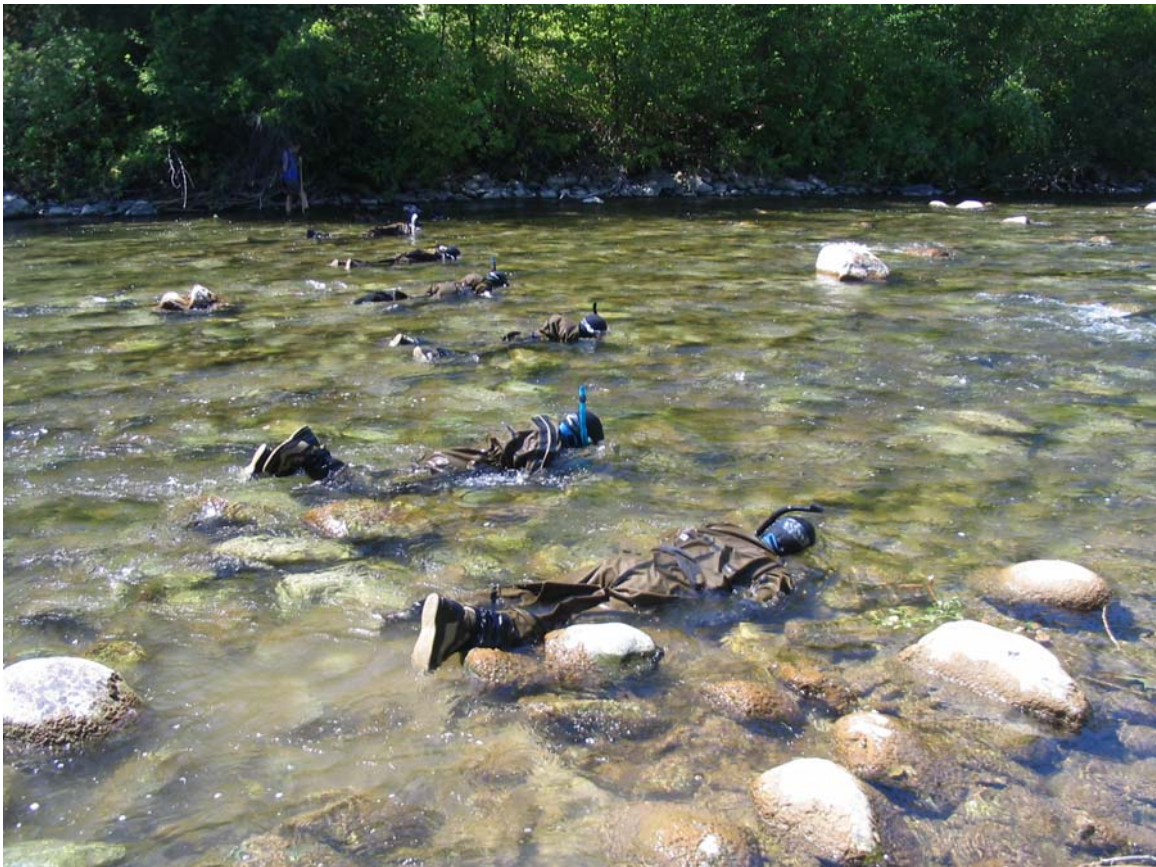


U.S. Fish & Wildlife Service

# Effectiveness Monitoring Program- Entiat River Bridge to Bridge Snorkel Surveys, 2005-2006.

---



U. S. Fish and Wildlife Service  
Mid-Columbia River Fishery Resource Office  
7501 Icicle Road  
Leavenworth, WA 98826

July 2006

# Effectiveness Monitoring Program- Entiat River Bridge to Bridge Snorkel Surveys, 2005-2006.

Draft Report  
July 2005- June 2006

Prepared by:  
R.D. Nelle  
Fishery Biologist

U.S. Fish and Wildlife Service  
Mid-Columbia River Fishery Resource Office  
7501 Icicle Rd.  
Leavenworth WA 98826

Funded by

U.S. Department of Energy  
Bonneville Power Administration  
Division of Fish and Wildlife  
Portland, OR. 97208-3621

Project No. 2003-017-00  
Contract No. 23744

July 2006

## **Disclaimer**

The mention of trade names or commercial products in this report does not constitute endorsement or recommendation for use by the federal government.

The correct citation for this report is:

Insert Citation

Effectiveness Monitoring Program-  
Entiat River Bridge to Bridge Snorkel Surveys, 2005-2006.

R.D. Nelle

Draft Final Report

*U.S. Fish and Wildlife Service  
Mid-Columbia River Fishery Resource Office  
7501 Icicle Rd.  
Leavenworth WA 98826*

## Table of Contents

Disclaimer .....	i
List of Tables .....	v
List of Figures .....	vi
Abstract .....	7
Introduction .....	8
Study Area .....	8
Methods .....	10
Site selection .....	10
Snorkel surveys .....	10
Results .....	11
Snorkel sites selection .....	11
Discharge .....	11
Water temperature .....	13
Turbidity .....	13
Overall snorkel survey count .....	14
Snorkel surveys by site .....	15
Discussion .....	22
Acknowledgements .....	23
References .....	23
Appendix .....	25

## **List of Tables**

Table 1. Experimental site descriptions and locations snorkeled in the Entiat River during 2005 to 2006. ....	11
Table 2. Water quality measurements for sites and times snorkeled in the Entiat River during 2005 to 2006. Discharge data is from USGS gage site number 12452990..	12
Table 3. The number of fish species observed by period and time of day during snorkel surveys in the Entiat River during 2005-2006. ....	14

## List of Figures

Figure 1. Study reach map of the Entiat River watershed and study reach from Rkm 5.2 to 10.9. ....	9
Figure 2. Daily mean discharge (ft <sup>3</sup> /sec) for the period from July 1, 2005 to June 30, 2006 for USGS gage station 12452990 at Rkm 2.3 in the Entiat River. ....	13
Figure 3. The number of fish by species enumerated during day and night snorkeling at 11 experimental sites in the Entiat River during 2005 to 2006.....	14
Figure 4. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Whitehall cross vane site (Rkm 5.5) during 2005 to 2006. ....	16
Figure 5. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River PUD canal site (Rkm 5.5) during 2005 to 2006 .....	16
Figure 6. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Dinkleman cross vane site (Rkm 7.4) during 2005 to 2006. ....	17
Figure 7. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Stanton-Love site (Rkm 8.4) during 2005 to 2006.....	18
Figure 8. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Hanan-Detwiler ditch site (Rkm 8.4) during 2005 to 2006. ....	18
Figure 9. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Jon Small barbs site (Rkm 8.8) during 2005 to 2006.....	19
Figure 10. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Knapp-Wham main site (Rkm 9.3) during 2005 to 2006. ....	20
Figure 11. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Knapp-Wham ditch site (Rkm 9.3) during 2005 to 2006. ....	20
Figure 12. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Wilson main site (Rkm 10.6) during 2005 to 2006.....	21
Figure 13. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Wilson side channel site (Rkm 10.6) during 2005 to 2006. ....	22
Figure 14. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Hatchery site (Rkm 10.9) during 2005 to 2006. ....	22

## **Abstract**

The USFWS Mid-Columbia River Fishery Resource Office conducted snorkel surveys at 11 sites and three seasonal periods during 2005 to 2006 as part of the Entiat River Bridge to Bridge Effectiveness Monitoring program. A total of 33,403 fish from 13 species/genus were enumerated. Rainbow trout were the overall most common fish observed and comprising 40% of fish enumerated followed by Chinook salmon (22%) and mountain whitefish (13%). Day and night surveys were conducted during the summer period (August) while night surveys were conducted during the fall (October) and winter (March) surveys.

## **Introduction**

This is first annual progress report to Bonneville Power Administration for the snorkel surveys conducted in the Bridge to Bridge section of the Entiat River as related to long term monitoring of restoration programs in this watershed.

In 2005, the Chelan County Conservation District (CCCD) in association with the Entiat Watershed Planning Unit (EWPU) initiated a large scale restoration program in the Entiat River watershed, known as the "Entiat Bridge-to-Bridge Project". This is a phased program that will over a several year period incorporate a suite of stream restoration measures that include in-stream habitat structures, the reconnection of relict stream channels, and riparian plantings. The restoration efforts in the Entiat River are intended to provide complexity to the river system and a positive benefit for aquatic organisms including ESA listed fish species.

The Entiat River Effectiveness Monitoring Study plans to evaluate fish utilization of in-stream habitat modifications within the Bridge to Bridge Reach of the Entiat River. The U.S. Fish and Wildlife Service's Mid-Columbia River Fishery Resource Office (MCRFRO) is conducting the snorkeling component of the Entiat Effectiveness Monitoring Study that will evaluate fish habitat utilization associated with in-stream restoration work planned for 1.2 miles (approximately 2000 meters) of the lower Entiat River referred to as the "Bridge to Bridge" reach.

The objective of this study is to monitor the fish habitat utilization of planned in-stream restoration efforts in the Entiat River by conducting pre and post construction snorkel surveys at selected control and treatment sites.

## **Study Area**

The Entiat River watershed originates from 11 glaciers and snowfields in the Cascade Mountains and flows southeast approximately 69 km to join the Columbia River at river kilometer (Rkm) 778 (CCCD 2004, Mullan et al. 1992). The Entiat watershed is bordered by the Entiat Mountains to the southwest and the Chelan Mountains to the northeast and drains approximately 1,085 km<sup>2</sup>. The topography is steep with unstable erodable soils and vegetations types varying from semi-arid steppe near the confluence with the Columbia River to temperate forests and alpine meadows in the headwaters.

Past glacial activity has shaped the Entiat River valley by creating a U-shaped valley upstream of terminal moraine at Rkm 26.1 and V shaped valley downstream (Mullan et al. 1992). The present upstream limit to anadromy is at Entiat Falls Rkm 54.4.

The study reach is located in lower Entiat River between the Rkm 5.2 to 10.9 (Rm 3.2 to 6.8) and the Bridge to Bridge section is located between Rkm 5.2 to 7.4 (Rm 3.2 to 4.6) (**Figure 1**).

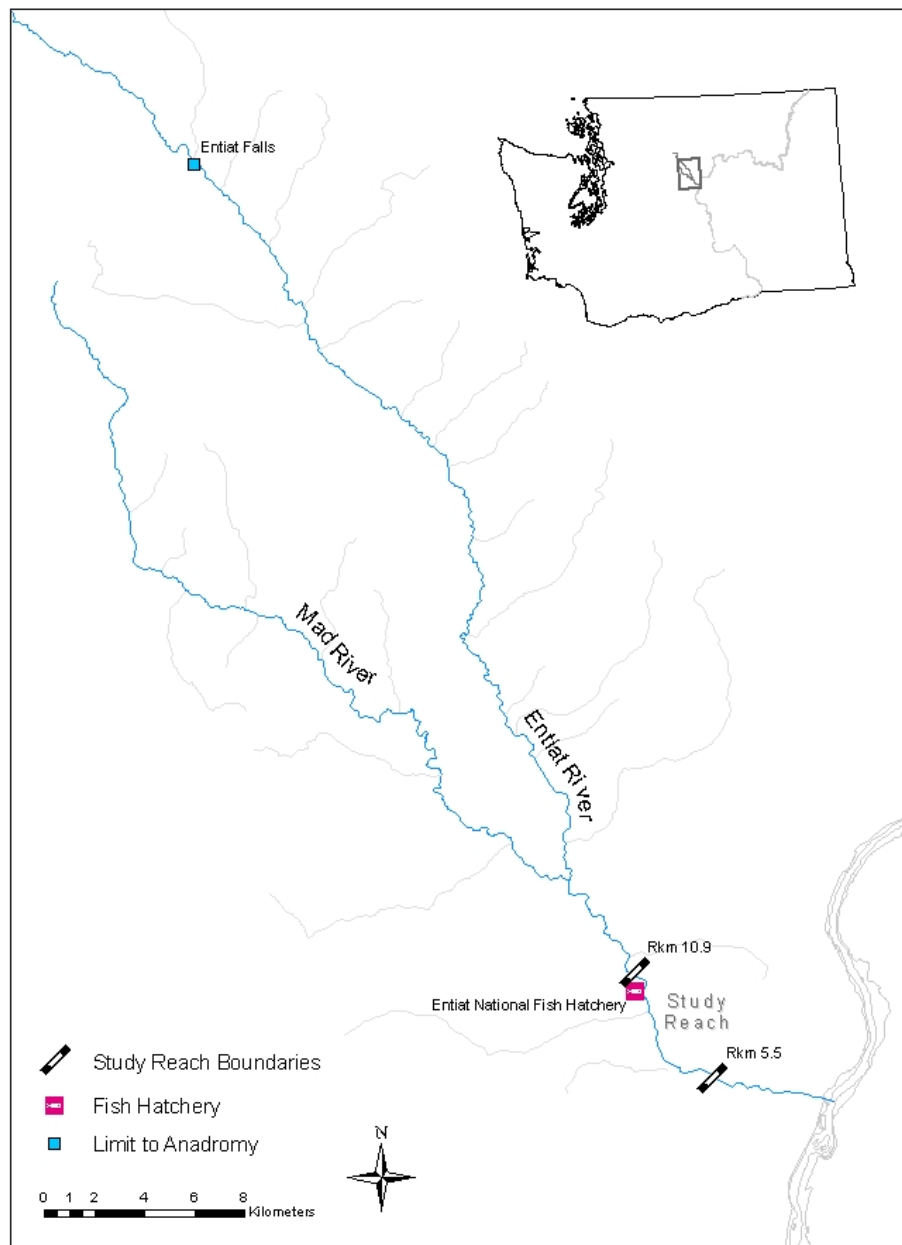


Figure 1. Study reach map of the Entiat River watershed and study reach from Rkm 5.2 to 10.9.

The Entiat River watershed supports seven native and one introduced salmonid species which include, spring and summer Chinook salmon *Oncorhynchus tshawytscha*, steelhead and resident rainbow trout *O. mykiss gairdneri*, sockeye salmon *O. nerka*, westslope cutthroat trout *O. clarki lewisi*, coho salmon *O. kisutch*, mountain whitefish *Prosopium williamsoni*, bull trout *Salvelinus confluentus*, and introduced eastern brook trout *S. fontinalis*. Other fish species include, northern pikeminnow *Ptychocheilus oregonensis*, largescale sucker *Catostomus macrocheilus*, bridgelip sucker *C. columbianus*, speckled dace *Rhinichthys osculus*, longnose dace *R. cataractae*, redbelt shiner *Richardsonius balteatus*, sculpin *Cottus spp.*, three-spined stickleback *Gasterosteus aculeatus* and Pacific lamprey *Entosphenus tridentatus*. (Mullan et al 1992, CCCD 2004, Wydoski and Whitney 2003).

## Methods

Fish were surveyed by direct observation using single-pass snorkeling as described by Thurow (1994) at eleven sampling sites during three survey periods.

### Site selection

Snorkel sites locations were identified jointly by USFWS and Terraqua, Inc. Site locations were defined by using locations of proposed habitat structures (treatment sites), locations of existing habitat structures (existing control sites), and information from Rosgen stream typing classification methods to select sites with a similar channel types as treatment sites for sites not subject to modifications (control sites).

Treatment and existing control sites were setup to place the area surveyed in the middle of the section to be modified or presently modified. All control sites and existing control sites were selected upstream of the Bridge to Bridge treatment section. Snorkel sites were defined to be 200m in length in the main river sites and 240m or less in off channel sites. Each site were further divided into habitat units, monumented, and flagged.

### Snorkel surveys

Snorkel surveys were conducted at three times periods throughout the year: the summer period (July/August after peak discharge), the fall period (mid-October/November), and the winter period (February/March). During each survey period, snorkeling was conducted at a night, however during the summer survey period an additional daytime snorkel was conducted at each site.

Night snorkeling commenced no earlier than 30 minutes past the official sunset at Entiat, WA or after the first star or planet was observed in the sky. Prior to night snorkeling, glow sticks were affixed at habitat unit breaks to assist crews in defining the sample site.

Up to eight snorkelers and at least one shore tender were used to conduct the snorkel surveys in the mainstem river snorkel sites. Off channel sites were snorkeled by one to four snorkelers depending on the site width. Snorkel crews entered the snorkel site downstream of the site and snorkeled as unit in an upstream direction to the end of that site. Snorkelers were positioned across the stream channel so as to cover the entire channel bank to bank. Shore tenders estimated fish numbers in the water too shallow to snorkel. Snorkelers used dry suits, wet or dry gloves, felt bottom wading boots, a mask and a snorkel. Hand-held dive lights were used at night to illuminate the survey area.

Data was recorded by each snorkeler on a PVC cuff secured to their arm and data was transferred to a datasheet at the end of each habitat units. Water temperature and turbidity were collected at the start of the survey. All fish observed were counted by species and assigned to a 20mm size class within each habitat unit.

In the office, data was transferred to a database and proofed for concurrence with field datasheets.

## Results

### *Snorkel sites selection*

A total of 11 sites were selected to snorkel. One planned main-river and 1 adjacent off channel habitat restoration treatment sites within the Bridge-to-Bridge reach were selected. Four pre-existing control sites were identified which included three main-river and one adjacent off channel site. Five control sites were selected which included three main river and two adjacent off channel sites. (**Table 1**).

Table 1. Experimental site descriptions and locations snorkeled in the Entiat River during 2005 to 2006.

Site name	Experimental site type	Channel location	River kilometer (km)	Site length (m)	Mid-point coordinates	
					Lat (N)	Long (W)
Whitehall cross vane	Treatment	Main	5.5	200	47.66920	120.28440
PUD canal	Treatment	Off	5.5	240	47.66860	120.28298
Dinkleman cross vane	Existing control	Main	7.4	200	47.67207	120.30595
Stanton-Love	Control	Main	8.4	200	47.67761	120.31252
Hanan-Detwiler ditch	Control	Off	8.4	200	47.67616	120.31201
Jon Small barbs	Existing control	Main	8.8	200	47.68088	120.31263
Knapp-Wham main	Control	Main	9.3	200	47.68556	120.31562
Knapp-Wham ditch	Control	Off	9.3	100	47.68609	120.31564
Wilson main	Existing control	Main	10.6	200	47.69548	120.32093
Wilson side channel	Existing control	Off	10.6	200	47.69606	120.32128
Hatchery	Control	Main	10.9	200	47.69869	120.32396

### *Discharge*

Daily average discharge for all sites and periods ranged from a low of 83 ft<sup>3</sup>/sec during the fall snorkel to a high of 140 ft<sup>3</sup>/sec during winter snorkel (**Table 2**). Daily average discharge with in sample period varied from 2 ft<sup>3</sup>/sec during the summer-night period to 19 ft<sup>3</sup>/sec during the fall period. Snorkel surveys were conducted during the lower water periods of the year, which is reflected in the yearly hydrograph (**Figure 2**). The two summer snorkel surveys were conducted during a period of stable but descending discharge. The fall snorkel survey was conducted during a low period that had slight fluctuations in discharge. The winter snorkel was conducted during a relatively stable period before the spring run off.

Table 2. Water quality measurements for sites and times snorkeled in the Entiat River during 2005 to 2006. Discharge data is from USGS gage site number 12452990.

Survey period- snorkel time	Site name	River kilometer	Snorkel date	Discharge (ft <sup>3</sup> /sec)	Temperature °C	Turbidity NTU
Summer-day	Whitehall cross vane	5.5	8/3/2005	115	20.4	1.0
	PUD canal	5.5	8/3/2005	115	17.0	0.9
	Dinkleman cross vane	7.4	8/4/2005	112	17.3	1.0
	Stanton-Love	8.4	8/4/2005	112	20.6	0.9
	Hanan-Detwiler ditch	8.4	8/4/2005	112	21.2	0.9
	Jon Small barbs	8.8	8/1/2005	124	18.1	0.8
	Knapp-Wham main	9.3	8/2/2005	121	15.4	0.9
	Knapp-Wham ditch	9.3	8/2/2005	121	16.2	NA
	Wilson main	10.6	8/2/2005	121	17.3	0.7
	Wilson side channel	10.6	8/2/2005	121	18.6	NA
	Hatchery	10.9	8/1/2005	124	20.2	0.8
Summer-night	Whitehall cross vane	5.5	8/11/2005	100	20.8	1.0
	PUD canal	5.5	8/12/2005	99	20.8	NA
	Dinkleman cross vane	7.4	8/10/2005	99	20.6	1.0
	Stanton-Love	8.4	8/8/2005	101	21.6	0.9
	Hanan-Detwiler ditch	8.4	8/9/2005	99	21.6	NA
	Jon Small barbs	8.8	8/9/2005	99	21.2	0.8
	Knapp-Wham main	9.3	8/9/2005	99	18.9	0.8
	Knapp-Wham ditch	9.3	8/9/2005	99	18.9	NA
	Wilson main	10.6	8/10/2005	99	19.5	1.2
	Wilson side channel	10.6	8/12/2005	99	NA	NA
	Hatchery	10.9	8/11/2005	100	18.8	0.8
Fall-night	Whitehall cross vane	5.5	10/20/2005	102	11.0	1.4
	PUD canal	5.5	10/16/2005	83	11.5	1.1
	Dinkleman cross vane	7.4	10/19/2005	96	11.5	1.3
	Stanton-Love	8.4	10/19/2005	96	12.3	1.0
	Hanan-Detwiler ditch	8.4	10/16/2005	83	NA	NA
	Jon Small barbs	8.8	10/17/2005	83	13.4	0.9
	Knapp-Wham main	9.3	10/17/2005	83	12.0	0.9
	Knapp-Wham ditch	9.3	10/16/2005	83	NA	NA
	Wilson main	10.6	10/18/2005	89	12.0	0.8
	Wilson side channel	10.6	10/16/2005	83	11.5	NA
	Hatchery	10.9	10/18/2005	89	12.0	0.8
Winter-night	Whitehall cross vane	5.5	3/8/2006	135	4.8	NA
	PUD canal	5.5	3/8/2006	135	4.0	1.0
	Dinkleman cross vane	7.4	3/7/2006	133	4.6	0.6
	Stanton-Love	8.4	3/7/2006	133	5.5	0.4
	Hanan-Detwiler ditch	8.4	3/5/2006	132	3.2	0.6
	Jon Small barbs	8.8	3/9/2006	140	4.0	NA
	Knapp-Wham main	9.3	3/9/2006	140	3.1	0.9
	Knapp-Wham ditch	9.3	3/8/2006	135	3.0	NA
	Wilson main	10.6	3/6/2006	133	5.2	0.9
	Wilson side channel	10.6	3/5/2006	132	2.9	0.6
	Hatchery	10.9	3/6/2006	133	4.5	0.6

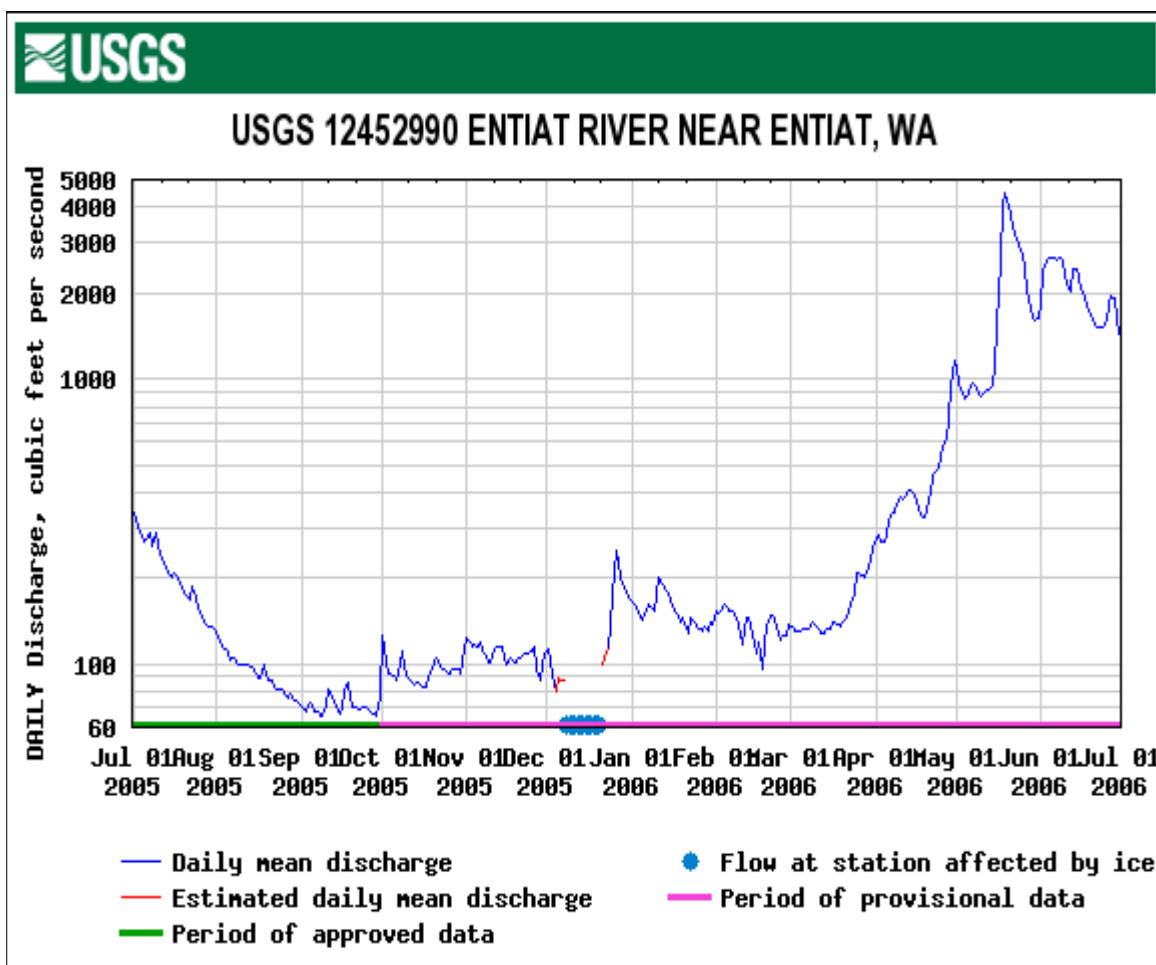


Figure 2. Daily mean discharge (ft<sup>3</sup>/sec) for the period from July 1, 2005 to June 30, 2006 for USGS gage station 12452990 at Rkm 2.3 in the Entiat River.

#### *Water temperature*

Water temperatures were relative consistent within a period however, during the summer day period daily water temperatures varied by 6.2 °C (range 15.4 to 21.6 °C) and mean value of 18.4 °C (SD 1.95; **Table 2**). The summer night period daily water temperatures varied by 2.8°C (range 18.8 to 21.6 °C) with a mean value of 20.4 °C (SD 1.13) . During the fall period, daily water temperatures varied by 2.4 °C (range 11.0 to 13.4°C) with a mean value of 11.9°C (SD 0.67). Daily water temperatures recorded during the winter period varied by 2.6 °C (range 2.9 to 5.5 °C) with a mean value of 4.1 °C (SD 0.92).

#### *Turbidity*

Mean water turbidity by period was  $\leq 1.0$  NTU (**Table 2**). The lowest turbidity levels were recorded during the winter snorkel period and the highest level recorded during the last part of the fall period.

### Overall snorkel survey count

All snorkel sites were successfully snorkeled during planned periods and times of day. A total of 33,403 fish were counted from all time periods and sites during 2005 to 2006 (**Table 3, Figure 3**). The greatest number of fish observed was during the summer-night period with 40% of the overall total, followed by summer-day (34%), fall-night (21%), and winter-night (5%).

Table 3. The number of fish species observed by period and time of day during snorkel surveys in the Entiat River during 2005-2006.

Fish species	Summer day	Summer night	Fall night	Winter night	Total
Bull trout	1	1	4	0	6
Chinook salmon	2,025	3,584	1,497	172	7,278
Coho salmon	10	1	3	0	14
Cutthroat trout	7	1	4	0	12
Dace spp.	458	1,604	712	41	2,815
Lamprey	1	6	3	10	20
Mountain Whitefish	1,580	2,545	294	18	4,437
Pikeminnow	4	8			12
Rainbow trout	4,073	3,287	4,154	1,529	13,043
Redside shiner	0	2	0	0	2
Sculpin spp.	16	241	144	34	435
Sockeye salmon	0	0	1	3	4
Sucker spp.	155	68	37	1	261
Unknown fish	3,141	1,903	9	11	5,064
Grand Total	11,471	13,251	6,862	1,819	33,403

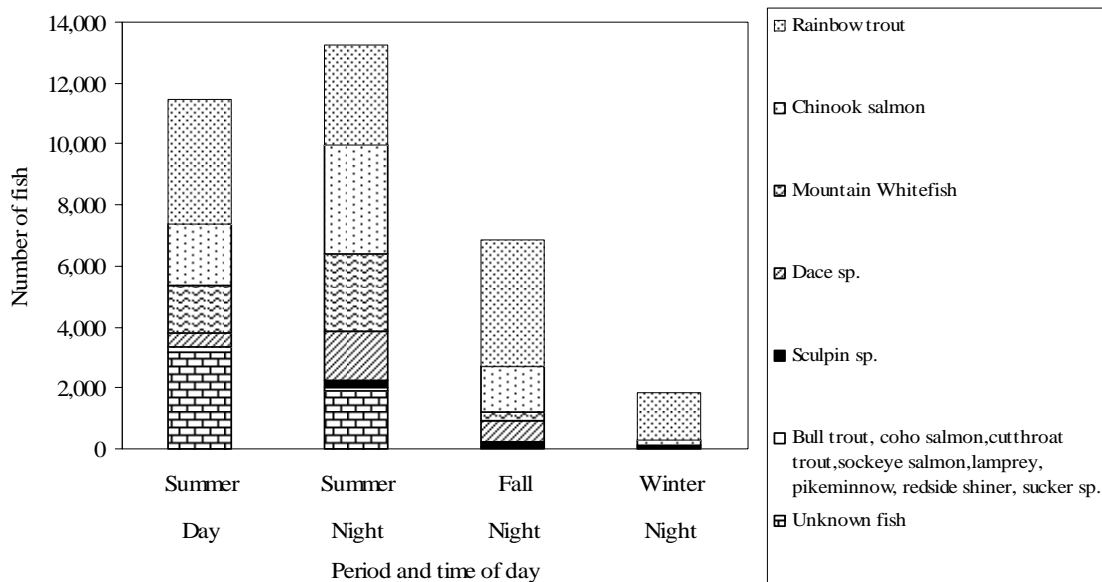


Figure 3. The number of fish by species enumerated during day and night snorkeling at 11 experimental sites in the Entiat River during 2005 to 2006.

For fish identified to species or genus, rainbow trout composed 39 % of the total observed count followed by Chinook salmon (22 %), mountain whitefish (13%), and dace sp. (8%). Unidentified species/genus fish composed 15% of the observed fish and were primarily juvenile or small fish observed in water to shallow to snorkel along the river margins. The remaining 3% of fish identified to species/genus were composed of bull trout, coho and sockeye salmon, cutthroat trout, lamprey, and pikeminnow, redbside shiner, sculpin spp., and sucker spp..

For seasonal time periods and time of day snorkeled, rainbow trout were observed in the greatest numbers in the summer-day, and the fall and winter night surveys. Chinook salmon were the most common during the summer-night survey followed by rainbow trout. The number of unknown fish decreased markedly during the fall and winter surveys.

The total numbers of Chinook salmon, dace spp., mountain whitefish, sculpin spp. observed increased during summer-night surveys compared to the summer-day surveys, while the number of rainbow trout decreased during the summer-night snorkel.

#### *Snorkel surveys by site*

The fish numbers counted by site is summarized in Appendix Table 1. The four overall most numerous fish species are represented by bars in Figures 4 through 14.

*Whitehall cross vane*-A total of 2,458 fish were enumerated at the Whitehall cross vane site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 85% of the total number at this site (**Figure 4**). Unknown fish accounted for 11% of the total fish counted and were primarily from the summer period. The remaining 4% of the fish encountered were bull trout, cutthroat trout, lamprey spp., and sculpin spp. The greatest number of fish observed by period was during the summer night snorkel (827).

*PUD canal*-A total of 1,585 fish were enumerated at the PUD canal site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 95% of the total number of fish observed at this site (**Figure 5**). Unknown fish accounted for 4% of the total fish counted, while the remaining 1% of the fish encountered were lamprey spp., redbside shiner, sculpin spp., and sucker spp. The greatest number of fish observed by period was during the summer night snorkel (589).

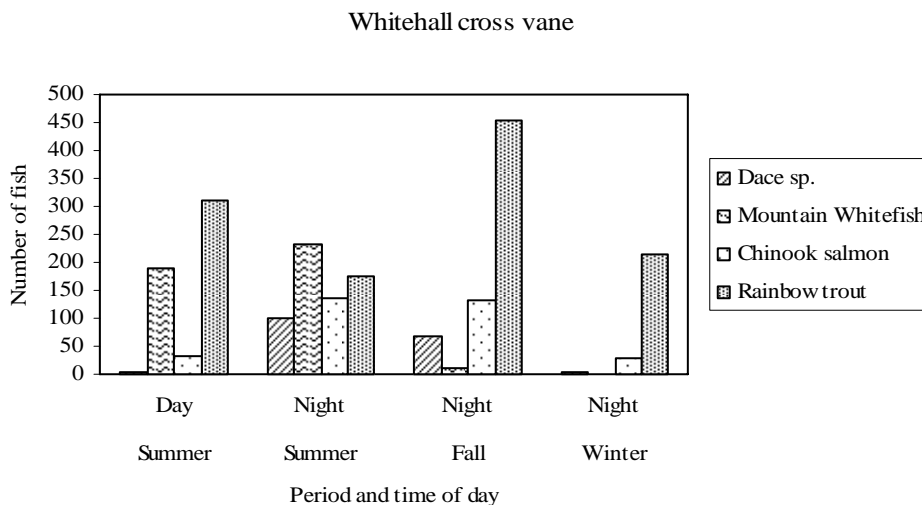


Figure 4. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Whitehall cross vane site (Rkm 5.5) during 2005 to 2006.

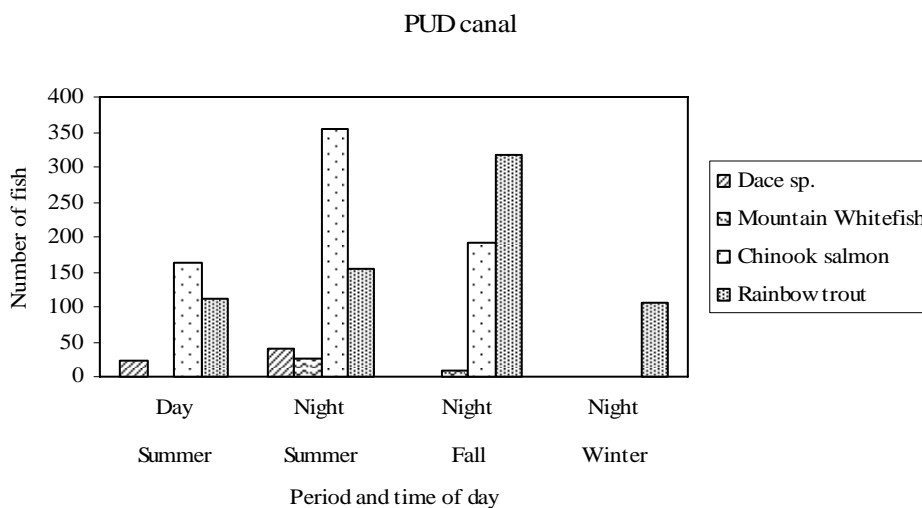


Figure 5. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River PUD canal site (Rkm 5.5) during 2005 to 2006

*Dinkleman cross vane*-A total of 4,034 fish were enumerated at the Dinkleman cross vane site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 78% of the total number of fish observed at this site (Figure 6). Unknown fish accounted for 18% of the total fish counted. The remaining 4% of the fish encountered were bull trout, cutthroat trout, lamprey spp., pikeminnow, sculpin spp.,

and sucker spp. The greatest number of fish observed by period was during the summer night snorkel (1,754).

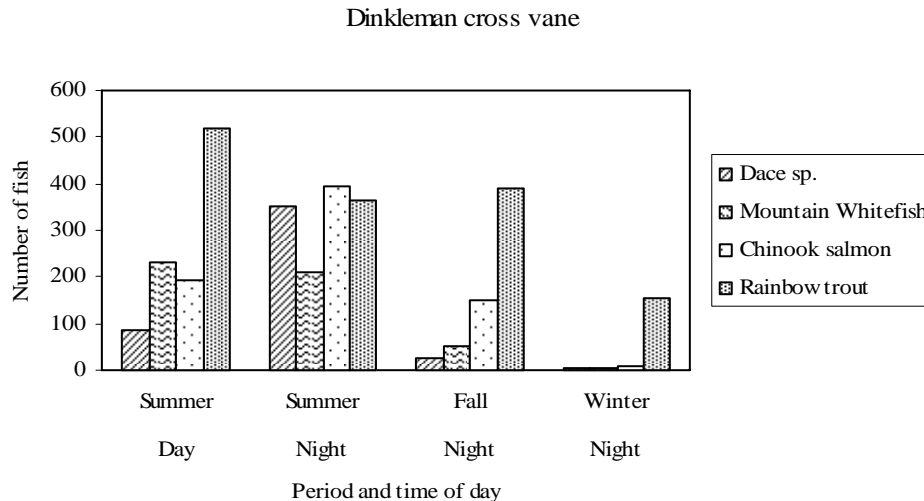


Figure 6. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Dinkleman cross vane site (Rkm 7.4) during 2005 to 2006.

*Stanton-Love-* A total of 5,575 fish were enumerated at the Stanton-Love site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 76% the total fish observed for this site (Figure 7). Unknown fish accounted for 22% of the total fish counted and was primarily from the summer period. The remaining 2% of the fish encountered were cutthroat trout, lamprey spp., pikeminnow, sculpin spp., and sucker spp. The greatest number of fish observed by period was during the summer night snorkel (2,317).

*Hanan-Detwiler ditch-* A total of 3,488 fish were enumerated at the Hanan-Detwiler ditch site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 100 % the total fish observed for this site (Figure 8). The other fish observed accounted for < 1% of the total number and were coho salmon, cutthroat trout, redbside shiner, sculpin spp. sucker spp.

*Jon Small barbs-* A total of 4,630 fish were enumerated at the Jon Small barbs site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 90% of the total observed fish for this site (Figure 9). Unknown fish accounted for 7% of the total fish counted and was primarily from the summer period. The remaining 3% of the fish encountered were bull trout, coho salmon, cutthroat trout, lamprey spp., pikeminnow, sculpin spp., sockeye salmon, and sucker spp. The greatest number of fish observed by period was during the summer night snorkel (1,536).

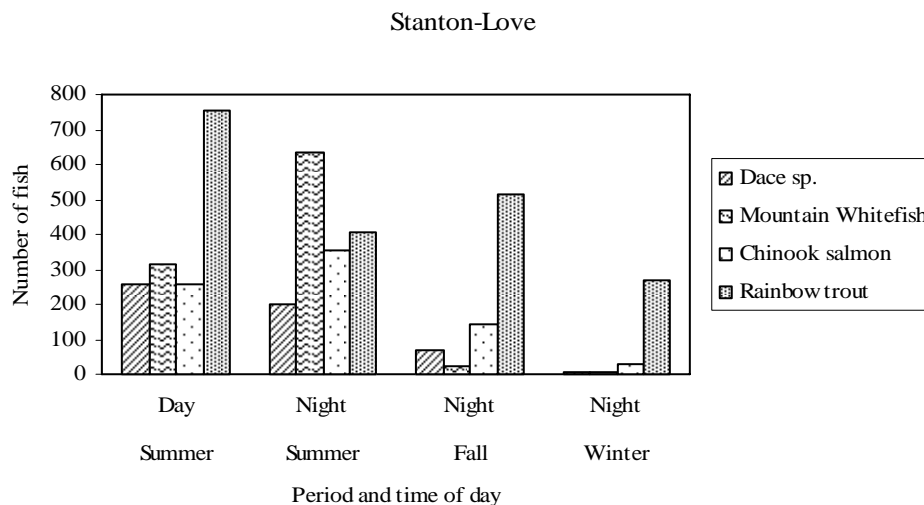


Figure 7. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Stanton-Love site (Rkm 8.4) during 2005 to 2006

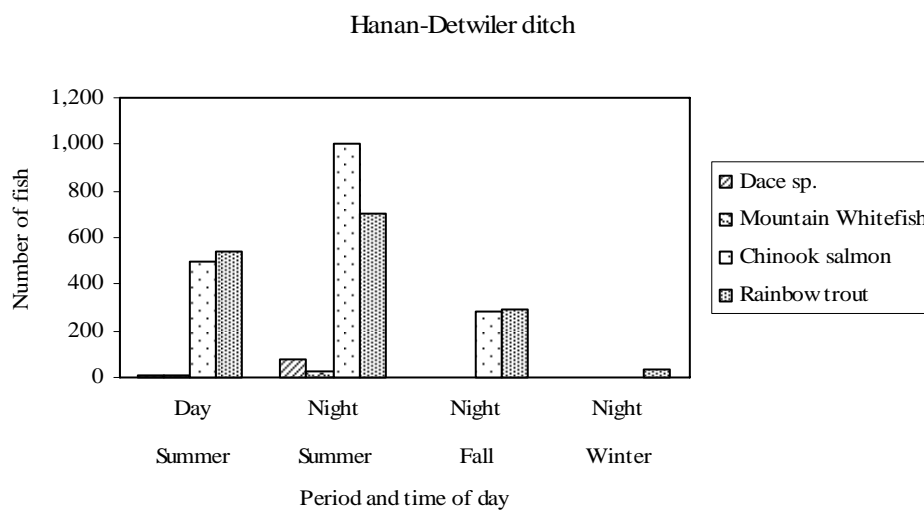


Figure 8. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Hanan-Detwiler ditch site (Rkm 8.4) during 2005 to 2006.

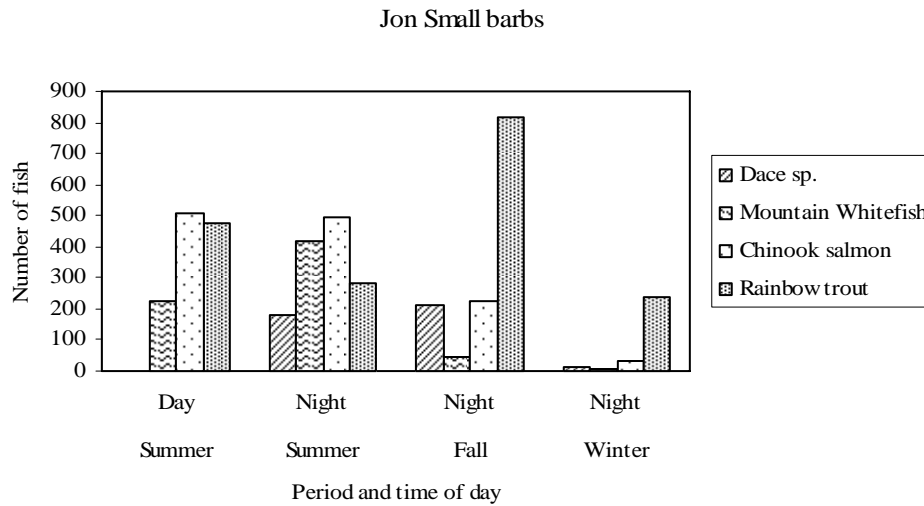


Figure 9. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Jon Small barbs site (Rkm 8.8) during 2005 to 2006.

*Knapp-Wham main-* A total of 2,909 fish were enumerated at the Knapp-Wham main site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 87% of the total fish observed for this site (Figure 10). Unknown fish accounted for 10% of the total fish counted and was primarily from the summer period. The remaining 3% of the fish encountered were bull trout, lamprey spp., pikeminnow, sculpin spp., sockeye salmon, and sucker spp. The greatest number of fish observed by period was during the summer night snorkel (1,449).

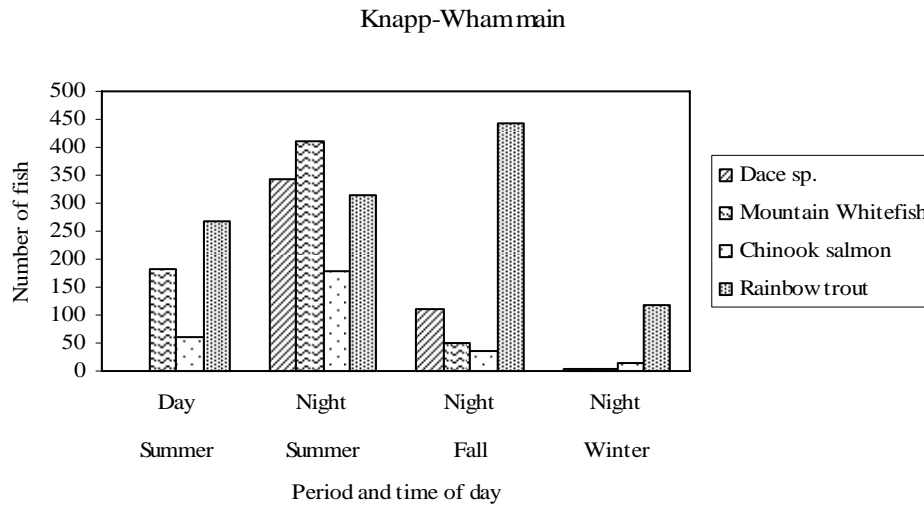


Figure 10. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Knapp-Wham main site (Rkm 9.3) during 2005 to 2006.

*Knapp-Wham ditch*- A total of 311 fish were enumerated at the Knapp-Wham ditch site (Appendix Table 1). Chinook salmon, dace spp., and rainbow trout accounted for 98% the total catch for this site (Figure 11). No mountain whitefish or unknown fish were recorded. The remaining 2% of the fish encountered were sculpin spp. The greatest number of fish observed by period was during the summer day snorkel (133).

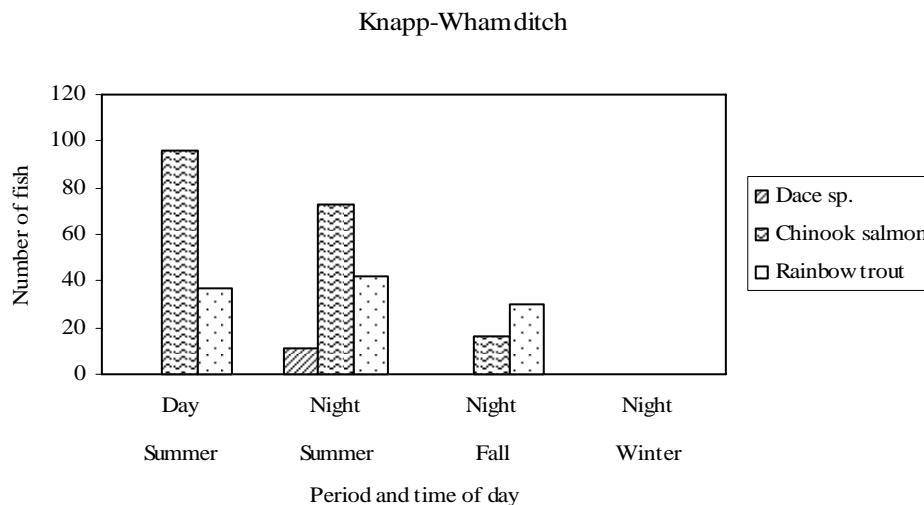


Figure 11. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Knapp-Wham ditch site (Rkm 9.3) during 2005 to 2006.

*Wilson main*- A total of 4,012 fish were enumerated at the Wilson main site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 50% the total catch for this site (Figure 12). Unknown fish accounted for 49% of the total fish counted and were primarily from the summer day period. The remaining 1% of the fish encountered were bull trout, coho salmon, cutthroat trout, lamprey spp., sculpin spp., and sucker spp. The greatest number of fish observed by period was during the summer day snorkel (1,950).

*Wilson side channel*- A total of 2,334 fish were enumerated at the Wilson side channel vane site (Appendix Table 1). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 100% the total catch for this site (Figure 13). Unknown fish accounted for < 1% of the total fish counted. The remaining fish encountered accounted for < 1% and were cutthroat trout, and sculpin spp., and sucker spp. The greatest number of fish observed by period was during the summer night snorkel (944).

*Hatchery*- A total of 2,067 fish were enumerated at the Hatchery site (Appendix Table 1. The number of fish observed during day and night snorkel surveys by site surveyed in the Entiat River during 2005 to 2006.). Chinook salmon, dace spp., mountain whitefish, and rainbow trout accounted for 88% of the total catch for this site (Figure 14). Unknown fish accounted for 8% of the total fish counted and were observed in summer and fall periods. The remaining 4% of the fish encountered were bull trout, coho salmon, sculpin spp., and sucker spp. The greatest number of fish observed by period was during the summer night snorkel (767).

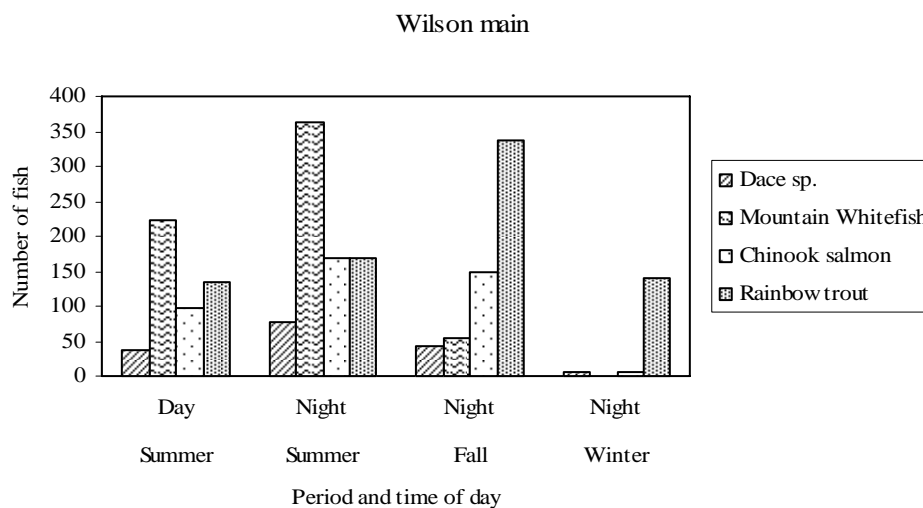


Figure 12. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Wilson main site (Rkm 10.6) during 2005 to 2006.

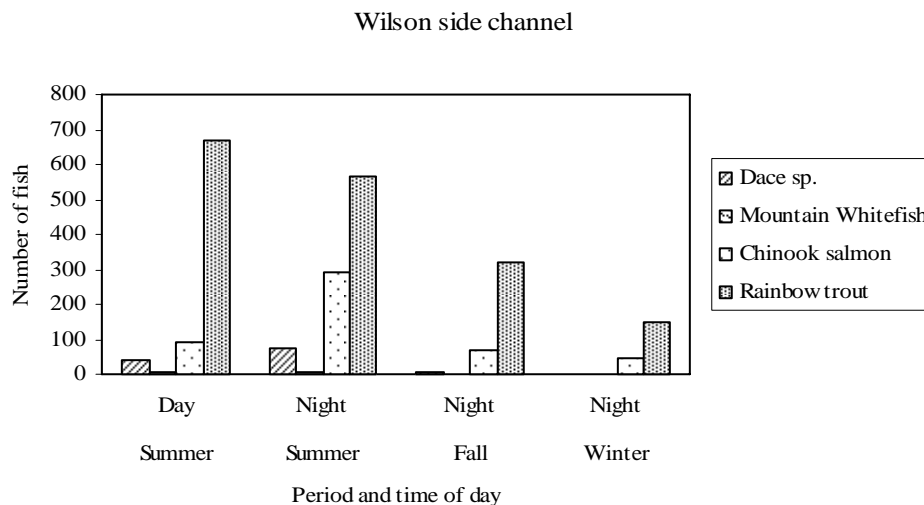


Figure 13. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Wilson side channel site (Rkm 10.6) during 2005 to 2006.

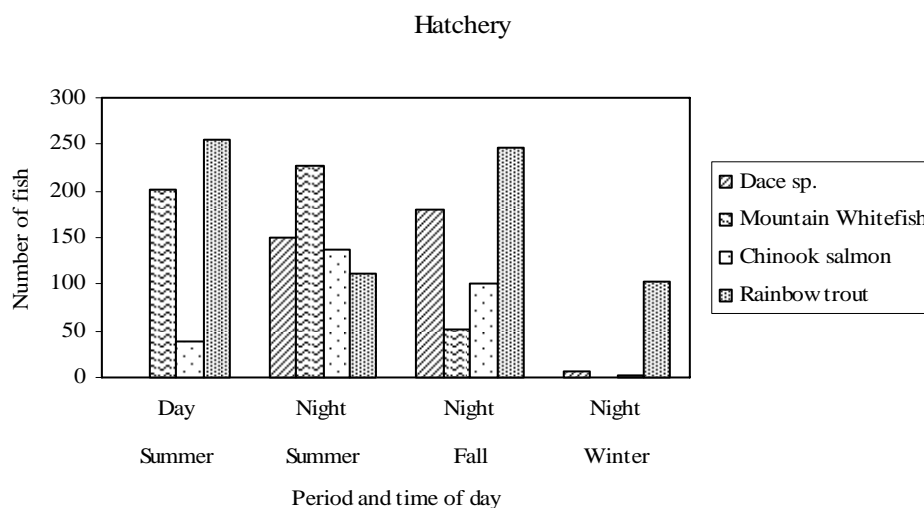


Figure 14. The number of rainbow trout, Chinook salmon, mountain whitefish, and dace spp. enumerated at the Entiat River Hatchery site (Rkm 10.9) during 2005 to 2006.

## Discussion

Snorkel surveys conducted by the MCRFRO in the Entiat River from 2005 to 2006 as part of the Bridge to Bridge Effectiveness Monitoring Project were conducted on time and within planned time periods. The number of snorkelers needed to accomplish this

study was originally under estimated by approximately half, however planned tasks were accomplished using volunteers and support from Leavenworth National Fish Hatchery. Future snorkel efforts will need to account for the additional snorkel effort needed to accomplish these snorkel surveys.

Snorkel surveys conducted during 2005 to 2006 were conducted under record low flow and low turbidity conditions thus creating ideal snorkeling conditions. Future conditions may not be as favorable to conduct snorkel surveys as during this pre-habitat modification period.

For main river sites Stanton-Love (control) site accounted for the largest number of fish observed followed by the three existing control sites: Jon Small barbs, Dinkleman cross vane, and Wilson main. Of interest is the greatest number of fish encountered by site was primarily at existing control sites where habitat modifications have been in place. Further analysis will be needed to address whether there are statistical differences between sites.

Project tasks were attained the MCRFRO for the 2005 to 2006 field season, and continued snorkel survey will be needed to evaluate the before and after restoration efforts and meet the long term effectiveness monitoring program goals in the Entiat River.

### **Acknowledgements**

Many thanks go to the core group of MCRFRO snorkelers. Additional thanks goes to the snorkeling support from Leavenworth National Fish Hatchery and support and shelter provided by Entiat National Fish Hatchery.

### **References**

Chelan County Conservation District. 2004. Entiat Water Resource Inventory (WRIA) 46 Management Plan. October 2004. Prepared for the Entiat Watershed Planning Unit by the Chelan County Conservation District. Wenatchee, Washington.

Hillman, T.W. 2003. Monitoring strategy for the Upper Columbia Basin: Draft Report December 1, 2003. Prepared for the Upper Columbia Regional Technical Team, Wenatchee, Washington.

Mullan J. W., K. R. Williams, G. Rhodus, T. W. Hillman, J. McIntyre. 1992. Production and habitat of salmonids in the mid-Columbia River tributary streams. U.S. Fish and Wildlife Service Monograph I.

Thurrow, R.F. 1994. Underwater methods for study of salmonids in the Intermountain West. Gen. Tech. Report INT-GTR-307. USDA, Forest Service, Intermountain Research Station. Ogden, UT.

Wydoski R. S. and R. R. Whitney. 2003. Inland Fishes of Washington. American Fisheries Society University of Washington Press.

## Appendix

**Appendix Table 1. The number of fish observed during day and night snorkel surveys by site surveyed in the Entiat River during 2005 to 2006.**

Site	Species	Summer day	Summer night	Fall night	Winter night	Sub- total
Whitehall cross vane	Bull Trout	0	0	1	0	1
	Chinook salmon	33	135	132	29	329
	Cutthroat trout	0	1	0	0	1
	Dace spp.	2	101	67	2	172
	Lamprey	1	0	1	1	3
	Mountain Whitefish	190	231	10	0	431
	Rainbow trout	309	175	454	213	1,151
	Sculpin spp.	2	30	9	0	41
	Sucker spp.	41	12	6	0	59
	Unknown fish	126	142	0	2	270
Sub-total		704	827	680	247	2,458
PUD canal	Chinook salmon	164	355	192	0	711
	Dace spp.	24	40	1	0	65
	Lamprey	0	0	0	1	1
	Mountain Whitefish	0	27	8	0	35
	Rainbow trout	111	154	317	105	687
	Redside shiner	0	1	0	0	1
	Sculpin sp.	2	1	6	0	9
	Sucker sp.	0	5	3	0	8
	Unknown fish	62	6	0	0	68
Sub-total		363	589	527	106	1,585
Dinkleman cross vane	Bull Trout	0	0	1	0	1
	Chinook salmon	192	393	152	9	746
	Cutthroat trout	1	0	2	0	3
	Dace spp.	86	352	26	3	467
	Lamprey	0	1	1	2	4
	Mountain Whitefish	232	210	53	5	500
	Pikeminnow	3	4	0	0	7
	Rainbow trout	518	363	390	153	1,424
	Sculpin spp.	4	41	11	1	57
	Sucker spp.	70	17	3	0	90
	Unknown fish	358	373	0	4	735
Sub-total		1,464	1,754	639	177	4,034

Appendix table 1. continued

Site	Species	Summer day	Summer night	Fall night	Winter night	Sub- total
Stanton-Love	Chinook salmon	256	354	142	30	782
	Cutthroat trout	0	0	1	0	1
	Dace spp.	255	198	68	4	525
	Lamprey	0	3	1	1	5
	Mountain Whitefish	314	634	22	3	973
	Pikeminnow	0	2	0	0	2
	Rainbow trout	754	404	514	271	1,943
	Sculpin spp.	5	29	36	10	80
	Sucker spp.	4	7	0	1	12
	Unknown fish	729	517	3	3	1,252
Sub-total		2,317	2,148	787	323	5,575
Hanan-Detwiler ditch	Chinook salmon	495	1,002	285	3	1,785
	Coho salmon	0	0	2	0	2
	Cutthroat trout	1	0	0	0	1
	Dace spp.	12	76	0	0	88
	Mountain Whitefish	8	22	1	0	31
	Rainbow trout	539	702	290	37	1,568
	Redside shiner	0	1	0	0	1
	Sculpin spp.	0	4	2	0	6
	Sucker spp.	0	3	3	0	6
Sub-total		1,055	1,810	583	40	3,488
Jon Small barbs	Bull Trout	0	0	1	0	1
	Chinook salmon	506	493	227	34	1,260
	Coho salmon	10	0	0	0	10
	Cutthroat trout	2	0	1	0	3
	Dace spp.	1	182	211	16	410
	Lamprey	0	1	0	1	2
	Mountain Whitefish	225	415	45	4	689
	Pikeminnow	1	0	0	0	1
	Rainbow trout	477	283	815	240	1,815
	Sculpin spp.	1	49	12	3	65
	Sockeye salmon	0	0	0	3	3
	Sucker spp.	28	9	9	0	46
	Unknown fish	216	104	5	0	325
Sub-total		1,467	1,536	1,326	301	4,630

Appendix table 1. continued

Site	Species	Summer day	Summer night	Fall night	Winter night	Sub- total
Knapp-Wham main	Bull Trout	1	0	0	0	1
	Chinook salmon	60	180	35	14	289
	Dace spp.	0	342	111	3	456
	Lamprey	0	0	0	1	1
	Mountain Whitefish	183	409	50	5	647
	Pikeminnow	0	2	0	0	2
	Rainbow trout	269	316	442	119	1,146
	Sculpin spp.	0	25	22	4	51
	Sockeye salmon	0	0	1	0	1
	Sucker spp.	8	6	0	0	14
	Unknown fish	131	169	1	0	301
Sub-total		652	1,449	662	146	2,909
Knapp-Wham ditch	Chinook salmon	96	73	16	0	185
	Dace spp.	0	11	0	0	11
	Rainbow trout	37	42	30	0	109
	Sculpin sp.	0	4	2	0	6
Sub-total		133	130	48	0	311
Wilson Main	Bull Trout	0	1	0	0	1
	Chinook salmon	96	170	148	5	419
	Coho salmon	0	1	0	0	1
	Cutthroat trout	2	0	0	0	2
	Dace spp.	38	76	42	6	162
	Lamprey	0	0	0	3	3
	Mountain Whitefish	223	364	53	1	641
	Rainbow trout	134	169	337	140	780
	Sculpin spp.	1	19	15	7	42
	Sucker spp.	3	5	7	0	15
	Unknown fish	1,453	492	0	1	1,946
Sub-total		1,950	1,297	602	163	4,012
Wilson side channel	Chinook salmon	89	292	67	45	493
	Cutthroat trout	1	0	0	0	1
	Dace spp.	39	77	6	0	122
	Lamprey	0	1	0	0	1
	Mountain Whitefish	4	5	0	0	9
	Rainbow trout	670	568	318	148	1,704
	Sculpin spp.	0	1	1	0	2
	Sucker spp.	0	0	1	0	1
	Unknown fish	0	0	0	1	1
Sub-total		803	944	393	194	2,334

Appendix Table 1. continued

Site	Species	Summer day	Summer night	Fall night	Winter night	Sub- total
Hatchery	Bull Trout	0	0	1	0	1
	Chinook salmon	38	137	101	3	279
	Coho salmon	0	0	1	0	1
	Dace spp.	1	149	180	7	337
	Mountain Whitefish	201	228	52	0	481
	Rainbow trout	255	111	247	103	716
	Sculpin spp.	1	38	28	9	76
	Sucker spp.	1	4	5	0	10
	Unknown fish	66	100	0	0	166
Sub-total		563	767	615	122	2,067
Grand total		11,471	13,251	6,862	1,819	33,403

**U. S. Fish and Wildlife Service  
Mid-Columbia River Fishery Resource Office  
7501 Icicle Road  
Leavenworth, WA**



**July 2006**